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Assessment of Nutritional Status and Fatigue among Army Recruits during the Army Common Recruit Training Course: Part A: Catering Services and Diet

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ABSTRACT

The nutritional status and fatigue level of Army recruits undergoing the Army Common Recruit Training (ACRT) course was assessed. This was achieved via the evaluation of the food services at the Army Recruit Training Centre, recruits dietary intake and the estimation of recruits total energy expenditure for the entire course and the most arduous activities of recruit training. Recruits were found to be consuming less energy than their requirements and a diet inappropriate for strenuous training – high in fat and low in carbohydrate. There was evidence that the recruits' nutritional requirements were not being met during the course: a small weight loss experienced by most recruits; comments by recruits and researcher observations; and the fact that recruits felt hungry between meals. During the study period recruits were provided with three meals per day. A more appropriate eating pattern would be three meals each consisting of a minimum 2.5 MJ to 4MJ and 100 to 140 g carbohydrate, and two or three between meal snacks each consisting of around 1 - 2 MJ and 50 - 100 g of carbohydrate. Extra energy supplied in the form of carbohydrate and different timing of meals would assist recruits through the very arduous days of the ACRT course.

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Assessment of Nutritional Status and Fatigue among Army Recruits during the Army Common Recruit Training Course: Part A: Catering Services and Diet

Executive Summary

The Commanding Officer/Chief Instructor of the Recruit Training Wing (CO/CI RTW) has observed that most recruits require long recovery times after physically demanding activities and lack energy during classroom activities.

CO/CI RTW requested that the Defence Science and Technology Organisation (DSTO) recommend nutritional strategies, which may lessen the observed level of fatigue among the recruits. The following specific questions were posed by CO/CI RTW:

1. What is the optimal nutritional intake for recruits undergoing the Army Common Recruit Training (ACRT) course?
2. How did the recruits diet rate? How did the food provided rate?
3. Are recruits meeting their nutritional requirements on the current basis of three meals per day? If not, can a more appropriate eating pattern be suggested?
4. Are there special nutritional requirements for the most demanding tasks such as the final Recruit Fitness Assessment, 7-km endurance march and Challenge?
5. Would recruits benefit from the provision of between-meal snacks and/or drinks?

The study was conducted in two phases; the first phase, which specifically addressed the questions posed above, is discussed in this report. The second phase, which concentrated on the health status of recruits, is addressed in part B of this report (to be published separately).

Researchers conducted a nutritional survey of meals and other food available to recruits from all sources at Army Recruit Training Centre (ARTC). Recruits from two platoons self-recorded their dietary intake at the beginning (food frequency questionnaire) and during their training (3-day food diary). Mean total energy expenditure was estimated for the group by the 'factorial method'. During the ACRT course, measurements were made of each recruit's height and on three occasions their weight was also measured.

The estimated food available to recruits from the Recruits Mess and other food outlets provided 18.8 MJ energy, 550 g carbohydrate, 200 g protein and 170 g fat per day.

The mean energy requirement (gender weighted mean) for most days of the ACRT course was 16.5 MJ. On the eight or so days where the activity level increased to a moderate level the energy requirement increased to about 18 MJ and on the most arduous day of the ACRT course (Exercise Dusty Warrior) it increased further to approximately 28 MJ.

Generally the recruits' energy intake was slightly less than their energy expenditure. They chose a diet, which had insufficient carbohydrate-rich foods and too many fat-rich foods. Snack foods available to recruits outside the mess were generally fat and sugar-rich and hence were not the best choice of food for a training diet. Although the results of the

recruits' food diaries represent an underestimate of their nutrient intakes, there is concern that recruits are at risk of under eating some nutrients, in particular carbohydrate, riboflavin and calcium.

There were also some concerns with the quality, quantity and delivery of food at the Recruits Mess, which should be addressed.

There was evidence that the recruits' nutritional requirements were not being met during the course: a small weight loss experienced by most recruits; comments by recruits and researcher observations; and the fact that recruits felt hungry between meals. During the study period recruits were provided with three – often hurried – meals per day. A more appropriate eating pattern for the recruits during their training would be three meals each consisting of a minimum of 2.5 MJ to 4MJ and 100 to 140 g carbohydrate, and 2 or 3 between meal snacks each consisting of around 1- 2 MJ and 50 - 100g of carbohydrate. Extra carbohydrate energy and different timing of meals would assist recruits through the very arduous days of the ACRT.

It is recommended that:

1. Catering contractors provide detailed menu information including standard recipes, serving sizes and records of consumption and waste to enable a thorough nutritional assessment (by an accredited practicing dietician) of the food provided in the Recruits Mess;
2. Problems identified with the quality and delivery of meals within the Recruits Mess be addressed;
3. Hot-boxed meals be improved;
4. Recruits be provided with at least two carbohydrate-rich between-meal snacks , each providing 50 - 100 g carbohydrate and ~1 - 2 MJ of energy. Two options are suggested for possible implementation:
 - a. The snacks can be derived from food already made available to the Recruits Mess (i.e. there is no extra entitlement to food beyond that currently provided by SUPMAN 4), or
 - b. A 'recruit supplement' could be devised that provides a minimum of 100 g carbohydrate (2 - 4 MJ of high-carbohydrate foods) to be issued as 2 between meal snacks to recruits in addition to the current entitlement under SUPMAN 4.
5. Recruits be encouraged to select low-fat, carbohydrate-rich snack foods from external food outlets, where possible;
6. An holistic approach to nutrition education be introduced which involves recruits, instructors and staff and management of the various food providers;
7. During 2004/05 DSTO conduct a follow-up survey of recruits' food consumption to evaluate any changes made to the food delivery systems; and
8. A diet modelling approach be used to assess the nutritional adequacy of the catering contract and associated aspects of the SUPMAN4.

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1. Introduction

The role of the Army Recruit Training Centre (ARTC) is to develop and deliver all-corps soldier training and adventurous training to the ADF, the primary focus being recruit training for the Regular Army and Army Reserve. During 2003, 3290 recruits completed the 45-day Army Common Recruit Training (ACRT) course. Training is conducted continuously over the 45 days with most days commencing at 0600 h and finishing at 2200 h. The course is both physically and psychologically demanding, leaving recruits with very little personal time. The Commanding Officer/Chief Instructor of the Recruit Training Wing (CO/CI RTW) has observed that most recruits require long recovery times after physically demanding activities and lack energy during classroom activities, many of which are programmed until 2010 h.

Both ACRT and international recruit training programs report high attrition rates [1]. Reasons for failure include injury or illness, self-requested discharge and poor psychological suitability [2]. In 1999, a cohort study of 1,317 recruits, undertaking the (then) 12-week basic training course at ARTC, recorded the discharge of 184 recruits (14% attrition rate). Most were discharged as “medically unfit” (59%), 23% were discharged at their own request and 18% were “not suited to be a soldier” [3]. A lower limb injury was sustained in 21% (276) of the recruits, with tibial fracture or periostitis accounting for 36% of these injuries. Injured recruits were ten times less likely to complete recruit training. Such attrition costs thousands of dollars per recruit – i.e. the combined costs of recruitment, relocation to ARTC, uniforms, equipment, accommodation, rations, wages, instruction and supervision, administration and health care.

CO/CI RTW requested that the Defence Science and Technology Organisation (DSTO) recommend nutritional strategies which may lessen the observed level of fatigue among the recruits. This report (Part A of *Assessment of nutritional status and fatigue among Army recruits during the Army Common Recruit training Course*) endeavours to answer the following specific questions posed by CO/CI RTW:

1. What is the optimal nutritional intake for recruits undergoing the ACRT course?
2. How did the recruits’ diet rate? How did the food provided rate?
3. Are recruits meeting their nutritional requirements on the current basis of three meals per day? If not, can a more appropriate eating pattern be suggested?
4. Are there special nutritional requirements for the most demanding tasks such as the final Recruit Fitness Assessment (RFA), 7-km endurance march and Challenge?
5. Would recruits benefit from the provision of between-meal snacks and/or drinks?

In order to answer these questions a survey of the food services and recruits dietary intakes was conducted, recruits’ body weights were monitored and their energy requirement estimated by use of observational studies.

The study was conducted in two phases; the first phase, which specifically addressed the questions posed above, is discussed in this report. The second phase, which investigated the proposition that recruits might display symptoms of overtraining, is addressed in part B of this report (to be published separately).

2. Methods

2.1 Participants and study protocol

2.1.1 Ethics approval

The experimental procedures were approved by the Australian Defence Human Research Ethics Committee (ADHREC protocol 333/03). All potential participants received copies of the information form and ADHREC's "Guidelines for Volunteers". Written consent was obtained from each participant after the details of the study had been explained and volunteers' questions had been answered. Copies of the forms are included in Appendix A.

2.1.2 Study protocol

The 45-day ACRT course involves activities ranging from 40-minute lessons – which can be sit-down classes, physical training or drill – to longer field-training sessions. All activities, including personal recreational time, need to be scheduled so that the demanding requirements of the course can be met within the 45-day timeframe. The tests that were required for the present study were no exception. The testing elements were scheduled into the formal ACRT course timetable for the participating platoons. Briefly, the testing schedule was as follows:

- dietary questionnaires/diary were completed on the day 1 and during week 5;
- fitness testing was conducted at the beginning (day 3, week 1), mid-course (day 18, week 3) and end-of-course (day 32, week 5);
- blood samples were collected on day 1, before (week 5, day 33) and after the final physical assessments (week 7, day 43);
- sleep and health diaries were completed each day, and
- the psychology questionnaires were completed on the same day each week.

This report (part A) deals with presentation of the dietary data, only. The remaining data is presented in Part B.

2.1.3 Participants

Recruits from two platoons were invited to take part in this study during 2003. Of 51 males (28 Regular Army and 23 Reservists) and seven females (two Regular Army, five Reservists) who volunteered for the study, five females and 38 males completed the ACRT course and the study.

The mean age of the initial group was 22.0 years for the males (range 18–33 years) and 29.5 years for the females (range 19–46 years). Mean height for males was 179.5 cm (range 164–196 cm) and females 165.0 cm (range 160–171 cm). Mean weight for males was 78.8 kg (range 60–104 kg) and females 64.5 kg (range 57–74 kg). Of the 38 males who completed the study, 14 (36%) were classified as *overweight* – body mass index (BMI) ≥ 25.0 – at entry to the ACRT course (mean BMI = 24.3, range 20.1–29.4) and two of the five females (40%) were *overweight* (mean BMI = 24.3, range 21.1–28.6). No recruits were classified as obese (BMI ≥ 30.0). Nine males and no females were cigarette smokers at commencement of the ACRT course.

2.2 Survey of Mess catering and other food outlets

The performance of the contract caterer with respect to meeting nutritional requirements stipulated in the contract impacts on the nutritional status of recruits. Non-nutritional aspects of the caterer's performance can also affect morale of recruits. Therefore, the opportunity was taken to compare catering at the Recruits' Mess with the requirements (both nutritional and non-nutritional) in the contract (Section 4 Hospitality and Catering Services).

The Prime Contractor for the provision of catering services at the Recruits Mess is BAE, with catering being subcontracted to Eurest Support Services (ESS). Catering effectiveness generally was subjectively assessed by interview with catering staff (particularly the head chef) and the ESS Site Manager at Kapooka, and by inspection, using a "Nutrition and Catering" checklist designed specifically for this study (Appendix B). The inspection of the Recruits Mess consisted of two visits approximately six weeks apart, encompassing three meal periods—breakfast and lunch (first visit) and dinner (second visit). The caterer received notification prior to each visit.

In order to perform a nutritional analysis of the mess catering, the menu was requested, including standard recipes and serving sizes. However, because the relevant information was not forthcoming, a detailed nutritional assessment of the menu could not be conducted.

Comments in the 'Customer Comments Book' at the Recruits Mess were noted for the preceding four weeks, for comparison with the results of the 'focus group' discussion and comparison with observations made during the two visits to the mess.

2.2.1 Focus group discussion

A 'focus group' session with the study group of 44 recruits was conducted on day 37 of the ACRT course. This took the form of questions/answers and open discussion. Appendix C summarises the discussion at the focus group meeting.

2.3 Dietary intake measurements

2.3.1 Usual diet before the ACRT course

Recruits' usual dietary intake prior to commencement of the ACRT course was estimated by use of a food frequency questionnaire (FFQ) developed by the Anti-Cancer Council of Victoria. This is a 96-item questionnaire that determines usual eating patterns. This FFQ has been validated and performs well compared to other methods used in this area [4]. Scanning and analysis of FFQ forms was conducted by the Anti-Cancer Council of Victoria, with data in the form of nutrient intakes returned to DSTO-Scottsdale.

2.3.2 Diet during the ACRT course

A 3-day food diary was used during the fourth week of the ACRT course to estimate eating patterns and usual dietary intakes of recruits. Participants were asked to record, at the time of consumption, all food and drinks consumed and the location of the meal. All meals and snacks

were recorded, with participants requested to record as much detail as possible – including brand names and serving sizes. The days included in the diary were selected to cover three typical days within the week in order to account for day-of-the-week effects [5]. The software program, Food Works version 3.1 (Xyris software, Brisbane, Queensland) with the nutrient database Aus Nut and Aus Foods (2002) were used to calculate participants' nutrient intakes.

2.3.3 Treatment of dietary data

Participants reporting energy intakes less than 0.9 of calculated basal metabolic rate (BMR) [6, 7] and participants who had completed either the FFQ or food diary incorrectly were excluded from dietary data analyses. Nine participants, including two females, were excluded from analysis of the FFQ data (dietary intake prior to recruitment) and three males were excluded from the analysis of the 3-day food diaries. Distribution of nutrient intakes below the Recommended Military Dietary Intake (RMDI) cut-offs [8] were determined and combined with probability statistics to calculate the number of participants likely to have reported intakes below their individual requirements. This approach recognises that the RMDI for nutrients (but not for energy) overestimates nutrient requirements of almost all individuals in the population [9].

Food risk was calculated by comparing each participant's intake of the major food groups against the "Core Food Groups" of the National Health and Medical Research Council (NHMRC) [Table 1, 10]. Based on the mean number of food serves consumed from each core food group, recruits were rated either "0" for meeting the core food group recommended serves or "1" for being outside the recommendation (e.g. fruit + vegetables + dairy products + meat + cereal products + extras gives a score from 0 to 6).

Table 1 Core Food Groups & Suggested (Minimum) Sample Serves per Day for the ACRT course

	Approx Energy per serve (kJ)	Example Serves	Recommended Serves (male)	Recommended Serves (female)
Cereal	600	2 slices bread, 1 med bread roll (65 g) 1 cup cooked rice, pasta, noodles (60g raw) 1 cup cooked porridge, 1.3 cup RTE cereal (~50 g raw) ½ cup natural muesli (50 g raw) 1/3 cup flour (50 g)	10	7 - 8
Vegetable	75-250	½ cup cooked vegetables (40 – 80 g raw) ½ cup cooked dried beans, peas or lentils (60 g dry) 1 cup salad vegetables 1 small potato (90 g)	5	5
Fruit	300	1 medium piece of fruit 2 small pieces of fruit 1 cup diced fruit pieces or canned fruit 1 ½ tablespoons sultanas, dried fruits ½ cup fruit juice	2-3	2
Dairy	375-730	1 cup milk (fluid) 1 cup soy milk 1.2 cup evaporated milk 2 slices cheese (45 g) 1 small carton yoghurt (200 g)	3	3
Meat	600-850	65-100 g cooked meat or chicken ½ cup cooked beans, lentils, chickpeas, split peas or canned beans (60- 70 g dry) 80-120 g cooked fish fillet 2 small eggs 1/3 cup peanuts, almonds	2 - 3	1 -2
Extra	600	1 doughnut 4 plain sweet biscuits 1 slice cake (40 g) 25 g chocolate (1/2 small bar) 2 tablespoons cream, mayonnaise 1 tablespoon butter, margarine, oil 1 ½ tablespoon sugar 1 can soft drink 1 small packet potato crisps (30 g) 1/3 meat pie or pasty 12 hot chips 1 ½ scoops ice-cream	3	2 -3

2.4 Physiological measurements

2.4.1 Anthropometry

The methods for recording anthropometric data were based on those of the International Society for the Advancement of Kinanthropometry [11]. Body weight (Model: 211FP, Mercury Scale Co. Pty Ltd) and stature (stadiometer Cat no. 4444, Ka We Mab) were recorded before breakfast during the blood collection sessions (i.e. days 1, 33 and 43). Participants were asked to drink at

least 500 mL of water the previous night to ensure a good hydration state for both blood collection and body weight measurement.

2.4.2 Energy expenditure

Total Energy Expenditure (TEE) was estimated by the factorial method (based on observations of activities and assigning values for the energy costs of observed activities) [12, 13]. Detailed records of recruits' activities were made on days 9, 35 and 38. A detailed observation of the Challenge exercise was also conducted. It was concluded that it would be too difficult to make detailed observations of Exercise Dusty Warrior (EX DW). Instead, TEE during EX DW was estimated using program information and advice from ARTC staff, in conjunction with tours of the exercise site and the specific routes taken for activities.

To estimate the mean daily TEE, each day's activities were classified as:

- intense (e.g. physical training lessons, marching to and from lessons, endurance marches, obstacle courses, field-training lessons involving high levels of exertion),
- moderate (e.g. daily tasks, military activities such as drill, training in living accommodation and other tasks allocated by training instructors), and
- sedentary (e.g. lectures, eating, resting while waiting for lessons, sleep and similar activities).

An average physical activity level (PAL) was determined for each day based on the breakdown of time spent in the activities, above. Days were categorised as low (PAL = 2.1), moderate (PAL = 2.3) or high (PAL = 2.9). TEE was then estimated for each day by use of participants' calculated BMR and average PAL.

2.5 Statistical analysis

Statistical analysis was conducted with the assistance of a professional statistician (Glen McPherson Consultancy). Statistical analyses were performed with SPSS (Statistical Package for the Social Sciences, version 12.0, 2003, SPSS, Inc., Chicago, IL, USA). Descriptive statistics were used to establish a measure of central tendency and presented as means, standard deviations, standard error and range. Data was initially checked for outliers and non-homogeneity of the population by use of pair wise scatter plots, box plots and Q-Q plots. Normality of population distributions was checked by the Shapiro-Wilk and Lilliefors tests. Where appropriate, data was Ln transformed to achieve normality. Significance was accepted at $p < 0.05$. Comparison of means was achieved by use of the paired t test with Levene's test used for comparison of variance.

3. Results and Discussion

3.1 Estimate of food and nutrients available at ARTC

A nutritional assessment of the meals provided by the Recruits Mess was not possible, because the contractor did not provide detailed menu information. Hence it was not possible to determine whether or not the requirements of the contract (i.e. basic food scale of 17 MJ as outlined in SUPMAN 4) were being met. Appendix D gives the nutritional breakdown for the serial items in the entitlement table, SUPMAN 4, Chapter 7.

Based on the food serials in this table, a menu would easily provide the daily requirements of energy, all micronutrients and carbohydrate. It could also easily provide an excessive amount of saturated fat and cholesterol, and insufficient monounsaturated fats. It is not clear whether the scale would allow the development of a menu that provides the recommended quantities of core food groups (see Table 1). The bread and cereals group was the food group at greatest risk.

Based on the SUPMAN 4 entitlement and foods provided outside the mess, the estimated food available to recruits should have provided 18.8 MJ energy, 550 g carbohydrate, 200 g protein and 170 g fat per day (Appendix D).

3.1.1 Researcher observations of catering at the Recruits Mess

Based on subjective information supplied by kitchen staff, it appears that most contract requirements were met. For example, appropriate styles of cooking were employed; only cooking oils that are low in saturated fat and rich in poly- and mono-unsaturated fats were used; and a wide range of nutritious salads were offered, either without added dressings or with low-fat dressing. Appropriately, vegetable and carbohydrate-rich dishes were offered first in the serving line and posters with positive nutrition messages were displayed on the walls.

Some criticisms are that more wholegrain and wholemeal breads, rice and pasta should be offered and that dried fruit and nuts could be offered more often. Some deviations from the contract included the limited range of fresh fruits, a disproportionate ratio of red meat to chicken, fish and eggs—with insufficient chicken and fish being offered—and low-joule cordials, decaffeinated coffee and rye bread not being offered.

While the absence of rye bread, which is apparently not liked by recruits, has little nutritional impact, the other deviations are of concern. A good variety of fruits would encourage recruits to eat more fruit, which is an important source of antioxidants and carbohydrates. Fish is an important source of essential omega-3 fatty acids, recommended for heart health and prevention of inflammatory disorders. Low-joule cordials should be available for those recruits who are overweight. Decaffeinated coffee should be available for recruits who are sensitive to the effects of caffeine (such as sleep disturbance).

Unlike at other Army messes, where attendance is not compulsory, at ARTC forecast numbers are consistently accurate for each day's attendance. One outcome of this is that food wastage should be relatively low (because extra food does not have to be prepared in case numbers are greater

than expected). ESS Site Manager estimates ~5% of servery food is discarded, with another ~5% (or less) lost as plate waste. The level of servery waste is very low, and compares favourably with the 11% reported in a previous survey conducted by DSTO in 1988 [14]. However, the earlier finding was based on objective measurement, while the estimate of 5% wastage is based on subjective evaluation and may be an underestimate.

3.1.2 Estimate of food and nutrients available outside the Recruits Mess

Recruits have limited access to food sources other than the food provided by the mess. Other available food sources include the Everyman (greatest access), with more limited access to food from the Padre, vending machines, commercial food outlets during the trip to the War Memorial and during local leave, food packages from family and friends, Frontline, and the Post Office. A reasonable estimate of average daily nutrient consumption by recruits from these sources is 1.1 MJ, 36 g carbohydrate (mostly as sugars), 4 g protein and 12 g fat—mostly saturated fats (Appendix D).

3.1.3 Focus group discussion

The following key points were taken from the focus group discussion (Appendix C).

Comments concerning the menu and quality of foods in the Recruits Mess:

Most recruits believed that the quality of the meals could be improved. Quantity and variety of dishes such as salads and vegetarian dishes were criticised. Recruits commented on the poor quality of some dishes. Examples are poorly cooked eggs at breakfast, “strange” salads, “off” fish, undercooked chops/steaks, poor cuts of chicken (too bony, not enough meat), poor quality custard. Recruits wanted more and a better choice of dairy foods, salads, fruit, and cereal and grain-based foods. They wanted more meat to make sandwiches, and snack items such as dried fruit, nuts or muesli bars, which could be taken away from the mess. Recruits were not happy that dishes from previous meals were often “recycled”.

3.2 Comments concerning the organisation of mealtimes and food delivery

Recruits made comments regarding poor organisation in the mess. For example, the later-arriving recruits often had to stand for unacceptably long times while bain-maries were refilled and fresh serving spoons, plates and cutlery were brought out of the kitchen. Particular complaints were that they would have to wait in line for steaks/chops to be served and that popular dishes would “run out” before the end of the meal. Recruits felt under pressure to cut meal times short and many would often throw “half” their meal away and occasionally skip meals so they could have time to complete various training-related tasks. Many stated that they would benefit if they had more time to eat, because some would eat more and others would eat more slowly.

Researchers observed that the average time a recruit spent in the mess was 14 minutes with a minimum of four and a maximum of 21 minutes. Although recruits appeared to spend little time in the mess, and didn’t linger after a meal, they generally seemed to be purposeful rather than rushed. An exception occurred on one occasion when recruits were required to be back in their

lines within six minutes of departing for the Mess (which was about one minute quick march from the lines).

Hot boxes were a problem. The serves were too small and the choices too limited. Recruits on restricted privileges (ROP) or visiting the regimental aid post (RAP) often missed a meal because hot boxes weren't organised for them.

Recruits favoured the provision of snack foods and drinks between meals in the mess. Most said they felt hungry between meals. They would particularly like to be able to eat snacks/drinks after physical training sessions, on the range and during the scheduled breaks between classes. They would like cordial to be available in their lines. They would be happy with foods that could be carried in their backpacks.

Comments regarding recruits' preferred foods and food choices:

Favourite dishes were the fried, baked or roasted meats and fast food items such as pies, hot dogs, burgers and chips. However, they would mostly choose the wet dishes such as stews/pasta and mashed potato/pumpkin because they could take a bigger serve and because of the time issues described above. Recruits avoided dishes that were poor quality, were served in small sizes, took too long to serve/eat or were too fatty, or when "the chef was rude". Fewer than 25% of the recruits said they chose foods for health reasons and only two recruits commented that they specifically chose carbohydrate-rich foods.

Focus group comments were consistent with the entries, recorded in the 'Customer Comment Book' at the Recruits Mess. On the positive side, there were many compliments to the caterers about particular menu choices that were greatly enjoyed, and also about the range and quality of menu choices at specific meals. The most common negative comments addressed the fact that many dishes "ran out" before the end of the meal, for example salad choices, casseroles/stews and ice cream. Often, insufficient plates and cutlery were provided at the start of the meal, so late-arriving recruits had to wait at the servery while fresh dinnerware was brought out.

Hydration:

All recruits stated that they were drinking fluids during the day other than at meal times. One recruit said that she consumed less than 2 L per day, six recruits commented that they consumed approximately 2 L and 37 (84%) stated that they consumed greater than 2 L per day (averaging approximately 4 L/day). Water was the main fluid consumed outside mealtimes.

3.3 Estimated energy expenditure

It was estimated in this study that, on average, male recruits expend ~17 MJ of energy and female recruits expend ~13 MJ of energy per day during the ACRT course. The gender-weighted mean daily TEE at ARTC, based on the ratio of females to males (15:85) (*pers. comm.* CAPT Richard Teis) was 16.5 MJ. This energy expenditure is similar to that determined by doubly-labelled water method during strenuous US marine corps training, namely 17 ± 4 MJ per day for males and 10 ± 1.3 MJ per day for females over 12 weeks [15].

Table 2 provides a breakdown of the ACRT course for both males and females according to physical activity (*low*, *moderate* and *high*) including the specific days involved in EX DW.

Physical workloads on most days of the ACRT course can be considered to be *low* intensity – the only high intensity days being at the end of the course (EX DW). However, it should be noted that in this study, the terms *low*, *medium* and *high* intensity are relative – even on *low* intensity days, recruits were probably engaging in a greater level of physical activity than would be regarded as usual for most civilian Australians of the same age. For example the physical activity level (PAL) used to estimate a recruit's EE for a low intensity day was 2.1, which would be considered a high-intensity day for their relatively sedentary civilian peer.

During the first four weeks of recruit training the intensity level is relatively stable, with the mean TEE approximately 16.5 MJ and 12.4 MJ for male and female recruits, respectively. In weeks 5 and 6, and at the beginning of week 7 there is an increase in the activity level of the recruits to high intensities, particularly during EX DW (conducted at the end of week 6 and the beginning of week 7).

Table 2 The total energy expenditure of male and female recruits involved in ACRT.

Male				
Day Type	PAL	No. of days	EE (MJ/day)	
			Mean	Range
Low	2.1	33	16.3	14.0 – 18.6
Moderate	2.3	8	18.0	15.5 – 20.6
High (same as EX DW day 3)	2.9	1	22.3	19.2 – 25.5
EX DW- Day 1	2.5	1	19.7	16.9 – 22.5
EX DW - Day 2	3.6	1	27.6	23.8 – 31.6
Ex DW - Day 3	2.9	1	22.3	19.2 – 25.5
Total (Mean)		45	17.2	15.1 – 19.4
Female				
Day Type	PAL	No. of days	EE (MJ/day)	
			Mean	Range
Low	2.1	33	12.1	11.7 – 12.6
Moderate	2.3	8	13.4	12.9 – 14.0
High (same as ExDW day 3)	2.9	1	16.6	16.0 – 17.3
ExDW - Day 1	2.5	1	14.6	14.1 – 15.2
ExDW - Day 2	3.6	1	20.6	19.8 – 21.4
ExDW - Day 3	2.9	1	16.6	16.0 – 17.3
Total (Mean)		45	12.8	12.5 – 13.2

3.4 Body weight changes during the ACRT course

There was a small weight loss among male recruits ($t = 3.3876$, $p < 0.001$) and a non-significant weight loss among female recruits ($t = 2.174$, $p = 0.095$). Ten males gained between 1% and 6% body weight, 25 lost between 1% and 11% body weight and one maintained his weight. Three females lost between 1% and 6% body weight and two maintained their weight. Weight loss of 10% or more can be of concern, particularly if these recruits were to start another course of rigorous physical training without sufficient rest, or if they continued to lose weight [16]. However, no recruits in this study dropped to an unhealthy BMI, and without data on body composition, the extent of fat or muscle loss cannot be estimated.

3.5 Estimated daily food and nutrient consumption

The mean self-reported levels of energy consumption by recruits before and during the ACRT course were 12.2 MJ and 10.4 MJ, respectively. Although dietary intakes estimated from the food diaries underestimates their usual diet, some generalisations can be made. For example, the diets were too high in fat – particularly saturated, animal-based fats (~1.8 times recommended level) and many recruits were at risk of under consuming one or more nutrients. The fat profile of the recruits' diet was 17% of energy as saturated fats, 13% from monounsaturated fats and 5% from polyunsaturated fatty acids. Figure 1 presents the estimated mean daily intake of nutrients during the ACRT course as a percentage of the RMDI and table 3 presents the mean and range of daily nutrient intakes.

Table 3 Mean daily consumption of nutrients by recruits prior to and during the ACRT course compared with requirements

Nutrient ^a	Sex	12 Months prior to ACRT				During ACRT			
		Mean ± SD	Range	Probability of inadequacy (%)	RMDI ^b	Mean ± SD	Range	Probability of inadequacy (%)	RMDI
Energy (MJ)**	M & F	12.2 ± 4.3	6.2 – 23.0	-	11.3	10.4 ± 1.9	7.2 – 15.1	-	16.5
Protein (g)**	M & F	140 ± 60	70 – 320	7.9%	100	105 ± 20	65 – 159	39.4%	120
Carbohydrate (g)	M & F	280 ± 91	150 – 500	62.1%	400	273 ± 66	127 – 432	96.5%	575
Fibre (g)	M & F	27 ± 9	12 – 52	NA ^c		25 ± 6	17 – 44	NA ^c	
Alcohol (g)	M & F	14 ± 16	0 – 73	NA ^d		-	-	-	
Vitamin C (mg)**	M & F	176 ± 90	43 – 420	0%	40	124 ± 54	46 – 307	7.0%	40
Thiamin (mg)**	M & F	2.3 ± 0.8	1.1 – 4.7	0.9%	1.2	1.9 ± 0.8	0.9 – 5.0	20.5%	1.6
Riboflavin (mg)**	M & F	3.2 ± 1.3	1.4 – 6.9	2.4%	1.8	2.0 ± 0.7	1.0 – 4.3	46.7%	2.4
Folate (µg)	M & F	370 ± 120	180 – 650	0.3%	200	314 ± 71	181 – 511	6.7%	200
Niacin (mg)**	M & F	33.8 ± 13.1	15.9 – 72.5	2.1%	19	45 ± 9	27 – 69	23.3%	26
Vitamin A (µg)**	M & F	1080 ± 390	360 – 2180	52.7%	750	1620 ± 820	770 – 5400	7.0%	750
Vitamin E (mg)	M & F	8.4 ± 3.0	3.3 – 17.5	42.7%	10	-	-	-	-
Magnesium (mg)	M & F	389 ± 126	186 – 694	13.0%	320	288 ± 53	218 – 436	28.3%	320
Calcium (mg)**	M & F	1100 ± 370	560 – 232	11.9%	800	620 ± 206	360 – 1240	56.4%	800
Phosphorus (mg)**	M & F	2140 ± 780	1080 – 4430	0%	1000	1550 ± 290	1080 – 2240	7.0%	1000
Zinc (mg)*	M & F	18.6 ± 8.0	8.8 – 41.9	6.6%	12	15.5 ± 3.7	9.5 – 25.8	9.0%	12
Iron-males (mg)**	M	20.0 ± 7.2	9.1 – 35.1	0%	7	16.1 ± 3.0	12.6 – 23.4	7.0%	7
Iron-females (mg)**	F	16.9 ± 8.4	8.3 – 27.2	38.6%	13	12.9 ± 2.3	11.1 – 17.7	18.7%	14

^a Significant differences between nutrient intakes at <0.01 (**) and <0.05 (*) are indicated. N = 50 (12 months prior to ACRT) N = 42 (during ACRT)

^b Energy requirements were estimated as being an a PAL of 1.5 for the 12 months prior to ACRT and 16.5 MJ as the gender-weighted mean of estimated requirements during the ACRT course. Other requirements were based on Forbes-Ewan C. "ADF Nutrient Requirements in the 21st Century – A Report on the Nutrient Requirements of ADF Members Engaged in Base, Operational and Training Activities" Defence Nutrition Research Centre, February 2002.

^c The National Health and Medical Research Council (NH&MRC) gives as a guideline a recommended minimum dietary intake of 30 g fibre per day.

^d The NH&MRC gives as a guideline a maximum daily intake of 40 g for men and 20 g for women.

Overall the macronutrient consumption of recruits changed little after recruitment. However there were some worrying changes in the consumption of particular food groups. Of most concern was the decreased consumption of breads and cereals, fruit and dairy foods, which resulted in the apparent increased risk of under consuming carbohydrate, riboflavin and calcium, in particular. This eating pattern was reflected in the comments made about the mess catering (section 3.1.3), that “Recruits wanted more and a better choice of dairy foods, salads, fruit, and cereal and grain-based foods”. Table 4 details the mean daily consumption of the core food groups and highlights the changed eating patterns.

The usual consumption of alcohol by the group was just under one standard drink per day (0.3 ± 0.5 serves, range 0.0–2.1, where one serve is approximately two standard drinks). Alcoholic beverages were not available to recruits during the ACRT course. Very few recruits ate fish regularly. One in four recruits ate fish at least once during the three days of the survey. However, nearly all recruits ate sausages, for example a mean consumption of 1.2 ± 0.9 sausages per day (range 0.0 – 3.7) was self-recorded per recruit during the three days of the survey. The most popular vegetable consumed by recruits during the ACRT course was mashed potato – this most likely accounted for the difference seen in vegetable consumption by recruits compared with their usual eating pattern before recruitment. Recruits ate too many serves from the ‘extra’ food group – more than they did before recruitment. This was mostly due to the increased consumption of dessert foods such as cakes, slices and ice cream at lunch and dinner. Food group extras at breakfast were mainly bacon and butter/margarine. Most recruits drank cordial (mean 1.2 serves per day) with some recruits having one or more glasses with each meal. The most eaten fruit items were fresh apples and fruit juices. Table 5 presents a breakdown by meal of the mean daily selection of food group servings eaten during the ACRT course.

Table 4 Mean daily serves of the core food groups eaten by recruits ^a

Food Group	12 Months prior to ACRT		During ACRT		Minimum Recommended for males
	Mean \pm SD	Range	Mean \pm SD	Range	
Bread, cereals, rice, pasta, noodles**	5.4 ± 2.1	1.1 – 10.9	2.9 ± 1.1	0.3 – 5.8	10
Vegetables, legumes	4.5 ± 3.7	0.6 – 21.2	4.8 ± 1.8	1.6 – 8.9	5
Fruit**	2.1 ± 1.5	0.0 – 5.5	1.1 ± 1.3	0.0 – 5.8	3
Milk, yoghurt, cheese**	2.6 ± 1.3	1.0 – 6.5	0.7 ± 0.5	0.1 – 2.2	3
Meat, fish, poultry, eggs, nuts, legumes	4.0 ± 2.5	1.0 – 12.0	3.2 ± 1.4	0.9 – 8.4	2
Extra foods and alcohol	4.3 ± 1.8	1.3 – 9.1	4.3 ± 1.80	0.0 – 9.1	3

^a Significant differences between nutrient intakes at <0.01 (**) are indicated.

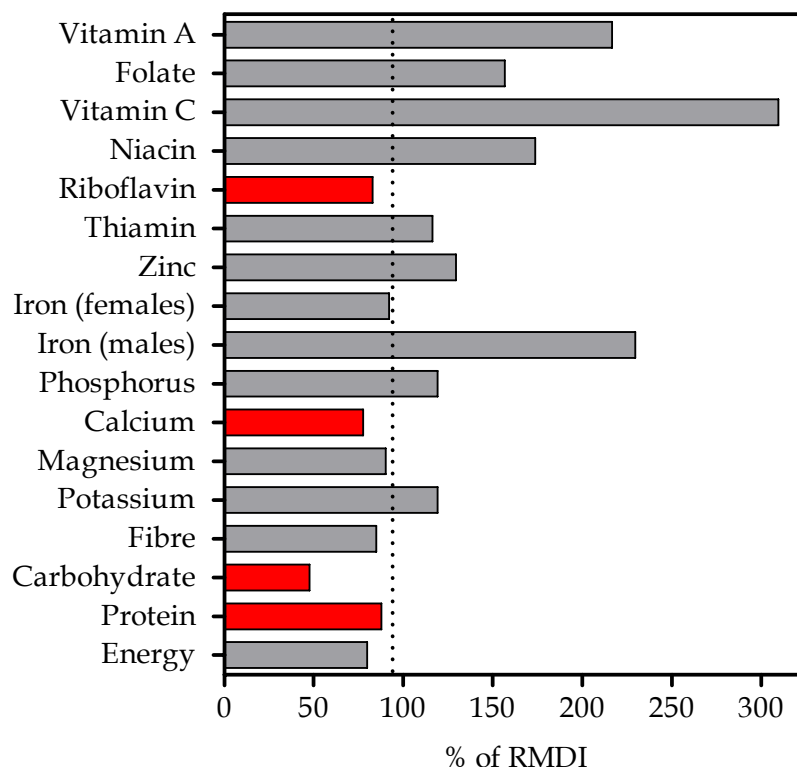


Fig 1. Nutrient intake by recruits during the ACRT course expressed as a percentage of RMDIs. Nutrients highlighted in red represent those which have a greater than 30% probability of being inadequate in the diet of this group of recruits

Table 5. Mean daily serves of food groups by recruits during the ACRT course according to meals^a

Food Group	Breakfast		Lunch		Dinner	
	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD	Range
Bread, cereals, rice, pasta, noodles	1.4 \pm 0.7	0.0 – 3.2	0.8 \pm 0.5	0.0 – 1.9	0.7 \pm 0.4	0.0 – 1.8
Vegetables, legumes	0.3 \pm 0.3	0.0 – 1.2	2.1 \pm 0.9	0.4 – 4.1	2.4 \pm 1.1	0.0 – 5.6
Fruit	0.4 \pm 0.5	0.0 – 2.1	0.3 \pm 0.5	0.0 – 2.3	0.5 \pm 0.7	0.0 – 2.5
Milk, yoghurt, cheese	0.4 \pm 0.2	0.0 – 1.0	0.2 \pm 0.2	0.0 – 0.9	0.1 \pm 0.2	0.0 – 1.0
Meat, fish, poultry, eggs, nuts, legumes	0.9 \pm 0.8	0.0 – 3.5	1.2 \pm 0.5	0.1 – 2.4	1.2 \pm 0.6	0.3 – 3.5
Extra foods	0.6 \pm 0.4	0.0 – 1.5	1.5 \pm 1.0	0.0 – 4.5	2.1 \pm 1.1	0.0 – 4.1

^aBetween-meal items have been included with the earlier meal. For example an apple eaten mid morning appears with Breakfast.

The mean diet risk score for this group in the 12 months prior to recruitment (4.6 ± 1.0 , range 2 – 6) did not change during the ACRT course (4.1 ± 0.8 , range 2.0–6.0). Figure 2 presents a picture of the overall dietary balance by detailing the distribution of food risk scores.

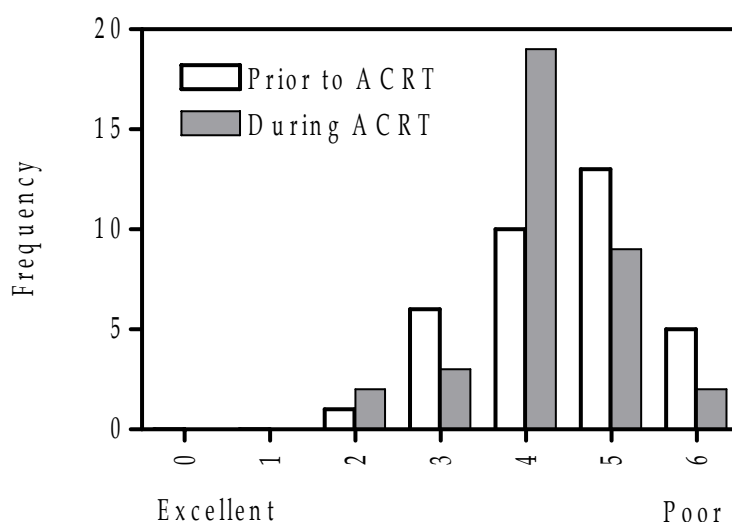


Fig 2. Frequency distribution of food risk scores before and during the ACRT course. A score of 0 indicates that all food groups are eaten daily in the amounts recommended.

4. Summary and Conclusions

4.1 What is the optimal nutritional intake for recruits undergoing the ACRT course?

The mean energy requirement (gender weighted mean) for most days of the ACRT course is 16.5 MJ. On the eight or so days where the activity level increases to a moderate level the energy requirement increases to about 18 MJ and on the most arduous day of EX DW the energy requirement increases to approximately 28 MJ. The micronutrient requirements (i.e. RMDIs) for these levels of energy expenditure are listed in a previous document [8].

4.2 How did the recruits' diet rate?

There were some changes in the recruits' eating patterns after recruitment. Of most concern was the decreased consumption of breads and cereals and dairy foods, which resulted in the apparent increased risk of under consuming carbohydrate, riboflavin and calcium, in particular. Generally during the ACRT course the recruits ate slightly less than their energy expenditure and chose a diet, which had insufficient carbohydrate-rich foods and too many fat-rich foods. The Australian

dietary guidelines are that total dietary fat intake should be 28% or less of dietary energy with no more than 10% being from saturated fatty acids and at least 14% being from monounsaturated fatty acids and 6% from polyunsaturated fatty acids. The fat profile of the recruits' diet was 17% of energy as saturated fats, 13% from monounsaturated fats and 5% from polyunsaturated fatty acids. This provides a pro inflammatory diet, which may contribute to symptoms of overtraining. Snack foods available to recruits outside the mess were generally fat- and sugar-rich and hence were not the best choice of food for a training diet.

4.3 How did the food provided rate?

The researchers are concerned that the caterers did not provide detailed menu information, to enable a full nutritional assessment of the food provided in the recruits mess. Consequently, the authors can only make generalisations about the food supplied by the mess and cannot comment on specific nutrients.

There were some concerns with the quality, quantity and delivery of food at the Recruits Mess, which should be addressed. Most notable were the complaints made by recruits regarding the quality of some menu items such as chicken and fish-based and vegetarian dishes, the limited choice of bread and cereal foods, dairy foods, salads and fruits and the apparent inability of the kitchen to provide sufficient food and eating utensils at the beginning of the meal time. The latter is particularly important given the time pressure that the recruits experience. The hot boxed meals were also a problem, with small serve sizes and limited choices being offered.

4.4 Are recruits meeting their nutritional requirements on the current basis of three meals per day? If not, can a more appropriate eating pattern be suggested?

The small weight loss experienced by most recruits coupled with the comments and observations detailed above and the fact that recruits felt hungry between meals strongly indicates that the recruits are not meeting their nutritional requirements on the basis of three (hurried) meals per day. Although the results of the recruits' food diaries represents an underestimate of their nutrient intakes, there is never-the-less concern that the recruits are at risk of under eating some nutrients, in particular carbohydrate, riboflavin and calcium.

A more appropriate eating pattern would be three meals each consisting of a minimum 2.5 MJ to 4 MJ and 100 to 140 g carbohydrate, plus two or three between-meal snacks, each consisting of around 1 -2 MJ and a minimum of 50g of carbohydrate. Extra energy supplied in the form of carbohydrate and different timing of meals would assist recruits through the very arduous days of the ACRT course. Appendix E provides an example 3-day meal plan for male and female recruits, which adheres to the Australian Guidelines for Healthy Eating [10] and provides specific advice to help recruits prepare for arduous activities such as the Challenge.

4.5 Are there special nutritional requirements for the most demanding tasks such as the final Recruit Fitness Assessment (RFA), 7-km endurance march and Challenge?

There is a small increased daily energy requirement to meet the demands of the RFA and the endurance march and up to 7MJ additional requirement on the days of the Challenge (Table 2). In particular additional energy derived from carbohydrate-rich foods is required. Ideally, the preceding main meal should be consumed at least an hour before the event and should be a high carbohydrate, low residue meal. Fatty and protein-rich foods should be avoided in the hours before the event. During endurance activities such as the march, recruits will need around 50 g of carbohydrate energy per hour and regular fluid intake. See Appendix E for more specific advice. Effective implementation of these guidelines will require specific nutritional instruction for recruits and training staff and liaison with caterers to ensure that the menu can accommodate the food selections recommended.

4.6 Would recruits benefit from the provision of between-meal snacks and/or drinks?

Recruits would benefit from easy access to drinks and snack foods outside the mess. The most obvious benefit would be that recruits should not feel hungry and should be less likely to feel that they have “no energy”. For most recruits, access to low-fat, carbohydrate-rich foods outside the mess and outside regular meal times would encourage greater food (and especially carbohydrate) consumption with a more even intake of food through the day.

5. Recommendations

1. The catering contractors should provide detailed menu information, including standard recipes, serving sizes and records of consumption and waste to enable a thorough nutritional assessment (by an accredited practicing dietician) of the food provided in the Recruits Mess.
2. Problems identified with the quality and delivery of meals within the Recruits Mess should be addressed.
3. Hot boxed meals need to be improved. In particular the serve sizes are too small and the variety of meals needs to be increased. The problem associated with providing meals to recruits who are on ROP or attending the RAP needs to be addressed.
4. The menu in the Recruits Mess should allow recruits to select a diet which meets the Australian Dietary Guidelines. A sample menu and specific advice is provided (Appendix E). On average, recruits should eat a minimum of 2.5 to 4 MJ per meal and at least two carbohydrate-rich snacks, each providing 50 - 100 g carbohydrate and ~1 - 2 MJ of energy. Two options are suggested on how this recommendation might be implemented:
 - a. The snacks can be derived from food already made available to the Recruits Mess (i.e. there is no extra entitlement to food beyond that currently provided by SUPMAN 4);

- b. A 'recruit supplement' could be devised that provides a minimum of 100 g carbohydrate (2 - 4 MJ of high-carbohydrate foods) to be issued as 2 between meal snacks to recruits in addition to the current entitlement under SUPMAN 4.

It is recognised that both these solutions will impose a cost on the catering services by way of additional staffing requirements and food and preparation costs.

5. Where possible, recruits should be encouraged to select low-fat, carbohydrate-rich snack foods from external food outlets. For example, it may be possible to stock vending machines with a better selection, or allow recruits to purchase the 'healthier' food choices from Frontline rather than restricting them to confectionary and soft drinks. Nutritional guidelines, such as those provided through the HOT (Healthy Options Tasmania) program could assist the external food outlets to provide a range of foods suitable for the recruits.
6. A holistic approach to nutrition education is needed. Such a program would not only include some formal lecture material for recruits and instructors, but also involve staff and management of the various food providers. In particular recruits need specific instruction in making appropriate food choices to meet the nutritional demands of arduous activities such as the 7-km march, Challenge and bayonet drills.
7. To evaluate any changes made to the food delivery systems, DSTO should conduct a follow-up survey of recruits' food consumption in the next financial year. This would most easily be accomplished by a survey conducted within the Recruits Mess.
8. A diet modelling approach should be used to assess the nutritional adequacy of the catering contract and associated aspects of SUPMAN 4. The selected diet models should take into account the possible extremes of consumption in terms of the amounts and types of food consumed and in so doing increase the probability that the actual diets of the recruits will fall into an eating pattern consistent with the Australian Dietary Guidelines.

6. Acknowledgements

The authors gratefully acknowledge the willing participation of the recruits of 35 Platoon and 36 Platoon, without whose cooperation the study could not have taken place. We are also very pleased to acknowledge the assistance of the Platoon staff, particularly LEUT Greg Mitchell and SGT Tyson. We would also like to extend our gratitude to CAPT Katrina Warfe, CAPT Raewyn Kirk-Lauritsen, CAPT Richard Teis, CAPT Andrew Baker, Ms Emma Stuart, CAPT Brett Woodward, Ms Anne Woodward and all of the staff at KMC for their continued support and assistance throughout this study.

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Appendix A: Consent & Information Sheets

CONSENT FORM

NUTRITIONAL REQUIREMENTS OF RECRUITS DURING TRAINING AT ARTC

I,..... give my consent to participate in the study mentioned above on the following basis:

- I have had explained to me the aim of this research, how it will be conducted and my role in it.
- I understand the risks involved as described in the information sheet.

I understand that:

- participation in the study is entirely voluntary and there is no obligation to take part in the study;
- had I chosen not to participate there would be no detriment to my career or future health care; and
- I may withdraw at any time with no detriment to my career or to my future health care.

I am co-operating in this study on condition that:

- the information I provide will be kept confidential;
- the information will be used only for this project;
- the research results will be made available to me at my request and any published reports of this study will preserve my anonymity; and
- all research data will be securely stored on the University of Tasmania premises for a period of 5 years. The data at the University will be destroyed at the end of 5 years.

I have been given a copy of the information sheet and this form, signed by me and by one of the researchers, Ms Bianka Skiller to keep. I have also been given a copy of ADHREC's *Guidelines for Volunteers*.

Should I have any complaints or concerns about the manner in which this study is conducted I will contact the researchers in person, or contact the Australian Defence Human Research Ethics Committee at the following address: Executive Secretary, ADHREC, CP2-7-66, Department of Defence, CANBERRA ACT 2600. Telephone: 02 6266 3837; Fax: 02-6266 4982.

Participant..... Date:.....

I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Bianka Skiller.....Date:.....

INFORMATION SHEET

NUTRITIONAL REQUIRMENTS OF RECRUITS DURING TRAINING AT ARTC

We would like to invite your participation in a study to document any fatigue-related symptoms you may experience and assess your nutritional requirements during the Army Common Recruit Training (ACRT) course.

WHY THIS STUDY?

Demanding training loads can result in a set of symptoms often referred to as over training (or over reaching). Fatigue or tiredness, illness--particularly in the second and third weeks and lack of concentration are symptoms experienced by some recruits during the ACRT. Common overtraining symptoms include constant tiredness, moodiness, under performance, frequent colds and sore throats, changes in immune function and hormonal levels and weight loss. The symptoms are more likely to develop when physical training is combined with other stresses such as mental stress, poor sleep and inadequate nutrition. Diets which are inadequate in carbohydrate and antioxidants and which are high in saturated fats and/or n-6 polyunsaturated fats can increase your risk of developing overtraining symptoms.

This study will document the over training symptoms experienced by your platoon (e.g. fatigue, mood, heart rate, immune function, blood levels of hormones, general health, physical performance) as well as the quality of your sleep and diet. We will also estimate the energy required to complete the more demanding physical tasks such as the endurance march, Exercise Dusty Warrior and the final Challenge.

Based on the information which your platoon provides to the researchers, changes may be made to mess catering and diet in order to eliminate problems of fatigue and under performance. These changes may involve not just changes in the composition of standard catering menus, but also delivery of meals, snacks and beverages tailored to meet the demands of specific training activities. The potential significance of these outcomes is improved effectiveness of ACRT due to a reduction in the prevalence of overtraining symptoms and an improved response to training.

Ultimately we (your instructors and Defence Science & Technology researchers) want to enable you to perform physically and mentally to your best capability.

YOUR PART IN THE STUDY

Tonight you will be asked not to eat or drink anything other than water after 22:00 h. Please remember to have a glass of water before attending the Kapooka Medical Centre.

Tomorrow morning your age, gender, weight and height will be recorded. You will be asked to complete questionnaires designed to record your usual diet (at home), your fatigue level, your state of mood and how you cope with stressful situations¹. The questionnaire session

¹ This last questionnaire will only be completed if time permits.

should take about 40 minutes and will be conducted before breakfast when you are attending the Kapooka Medical Centre.

While at the medical centre you will be asked to donate a blood sample (20 mL) and a saliva sample (before breakfast). These tests measure your immune function, antioxidant capacity, mild inflammation and a marker of over training. The key test for signalling the onset of over training is called the FTCT— or free testosterone to cortisol ratio. The FTCT represents a balance between anabolic (ie growing) and catabolic (ie breaking down) activity within the tissues. A decrease in FTCT of 30% or more signals the onset of over training.

Your saliva will be tested for a marker of stress called immunoglobulin-A. This is a test often used by athletes to show when their immune function is decreasing—a time when they may be at high risk of catching a head cold or sore throat. You will be asked to donate several saliva samples during the first week of the ACRT.

The pre-breakfast blood and saliva collection session will take about 1 hour for your platoon.

Every day: You will be asked to complete a simple sleep diary (immediately before bed and upon waking) and health checklist first thing every morning. This will give us information about how tired or sleepy you are at night, how well you are sleeping and any minor health problems you are experiencing. You will also be asked to record your resting heart rate— your heart rate gives us some information about your body's response to physical training. This should take less than 5 minutes.

Each week: At the end of each week you will be asked to complete 2 questionnaires which describe your level of tiredness/fatigue and state of mood during that week. This should take no more than 10 minutes. You will also be asked to provide a saliva sample (3-5 minutes).

During physical training sessions: Your physical fitness progress will be monitored under the supervision of your physical training instructor. The results of some simple tests designed to measure your aerobic fitness, endurance and muscular strength will be recorded for this study as part of your planned lessons.

Mid-course: During week 4 you will be asked to complete a food diary on three separate days. This should take no more than 15 min on each of the 3 days. [You may also be asked to donate additional saliva samples and to complete a questionnaire which asks you how you are coping with the demands of the course.²]

Weeks 6 and 7: You will be asked to donate a blood and saliva sample on one morning either late week 5 or early week 6 and one morning mid week 7. These will be a repeat of the blood and saliva testing conducted at the commencement of your course ie about 1 hour require--before breakfast--for your platoon on each occasion.

At various times during these weeks you will be asked to donate additional saliva samples.

² These additional tests (saliva and the questionnaire) will only occur if time permits.

At the completion of Exercise Dusty Warrior you will be asked about the food (combat rations) you ate during the exercise – a simple food checklist. This should take no more than 10 minutes.

Additional medical information and the Defence Injury Prevention Program: During the ACRT any injuries or illnesses you have will be recorded by Defence Health for the purpose of the Injury Prevention Program. The data collected during your ACRT, which includes that described above as well as the information collected by Defence Health for the Injury Prevention Program will be exchanged so that a complete picture of any injury, illness and OTS symptoms can be viewed in order to improve the ACRT course.

WHAT ARE THE RISKS OF PARTICIPATION ?

The risks involved in having a blood sample taken are no higher than they are for a routine medical examination. An experienced phlebotomist ('blood collector') will place a tourniquet around your upper arm then draw a blood sample from the inside of your arm into a syringe. Apart from a small prick when the needle pierces the skin, little discomfort is experienced by most people. However, if the procedure makes you feel faint, you should remain sitting and place your head between your knees. By applying pressure on the puncture site after the needle is withdrawn, you may prevent any bruising.

The use of sterile technique by the phlebotomist will prevent the risk of infection.

The study also requires saliva samples. The samples will be collected using Salivettes (Sarstedt Australia); a product designed specifically for the collection of saliva samples. You will chew on a small cylinder of cotton wool (for about 2 minutes) that is then hygienically sealed and stored under refrigeration.

All consumables used to sample blood and saliva (eg. needle, gloves, swabs, tape, Salivettes) will be sterile prior to use, and the sterile technique used by the phlebotomist and laboratory researcher will prevent the risk of infection. Conventional medical practice and standards for handling human tissue will be followed in the collection and handling of blood and saliva at all times.

The physical fitness testing will be supervised by your physical training instructor and personnel with first-aid qualifications will also be in attendance. The tests will be terminated if you indicate that you cannot continue, feel nauseous or become disorientated, or at the discretion of the PT staff, or the investigator.

HOW DO I FIND TIME TO PARTICIPATE?

Whilst involved in this study you will be considered to be 'on duty'. All of the activities will be conducted within the hours you are considered to be 'on duty'. Except for the daily sleep diary and health checklist all activities associated with this study will be scheduled into your formal timetable.

STATEMENT OF PRIVACY

Your participation in this study is voluntary. You are free to withdraw from the study at any time without detriment to your military career or health care. The information collected will be kept confidential, will be secure in a locked cabinet and nothing will be published which will identify individual participants. Your test results will not be placed on any of your Army or medical files. The information will only be used for this study as specified above. Investigators will not comment on your food selections, blood or saliva results, physical fitness results or answers to questionnaires during this time. A copy of your results and the final study report will be made available to you upon your request.

You will be given a copy of this information sheet and a copy of the statement of informed consent to keep.

Should you have any questions, concerns or complaints about this study and the way in which it is conducted, or if you would like to obtain an assessment of your dietary intake on conclusion of the study, please do not hesitate to contact the investigators:

Christine Booth, Accredited Practicing Dietitian OR Bianka Skiller
Defence Science and Technology Organisation
PO Box 147 Scottsdale Tas 7260; email: christine.booth@dsto.defence.gov.au; OR
bianka.skiller@dsto.defence.gov.au

OR you may contact the Australian Defence Medical Ethics Committee :

Executive Secretary
Australian Defence Human Research Ethics Committee
CP2-7-66
Canberra ACT 2600
Ph: 02 6266 3837, Fax: 02 6266 4982; Email: ADHREC@defence.gov.au

GUIDELINES FOR VOLUNTEERS

AUSTRALIAN DEFENCE HUMAN RESEARCH ETHICS COMMITTEE

GUIDELINES FOR VOLUNTEERS

Thank you for taking part in Defence Research. Your involvement is much appreciated. This pamphlet explains your rights as a volunteer.

What is ADHREC?

- ADHREC is the Australian Defence Human Research Ethics Committee. It was established in 1988, as the Australian Defence Medical Ethics Committee (ADMEC), to make sure that Defence complied with accepted guidelines for research involving human beings.
- After World War II, there was concern around the world about human experimentation. The Declaration of Helsinki was made in 1964, which provided the basic principles to be followed wherever humans were used in research projects.
- The National Health & Medical Research Council in Australia (NHMRC) published a set of guidelines in 1982 for how human research should be carried out.
- ADHREC follows both the Declaration of Helsinki as amended, and the NHMRC Statement.

What ADHREC approval means

- If you are told that the project has ADHREC approval, what that means is that ADHREC has reviewed the research proposal and has agreed that the research is ethical.
- ADHREC approval does not imply any obligation on commanders to order or encourage their troops to participate, or to release troops from their usual workplace to participate. Obviously, the use of any particular troops must have clearance from their commanders but commanders should not use ADHREC approval to pressure troops into volunteering.

Voluntary participation

- As you are a volunteer for this research project, you are under no obligation to participate or continue to participate. You may withdraw from the project at any time without detriment to your military career or to your medical care.
- At no time must you feel pressured to participate or to continue if you do not wish to do so.
- If you do not wish to continue, it would be useful to the researcher to know why, but you are under no obligation to give reasons for not wanting to continue.

Informed consent

- Before commencing the project you will have been given an information sheet which explains the project, your role in it and any risks to which you may be exposed.
- You must be sure that you understand the information given to you and that you ask the researchers about anything of which you are not sure.

- If you are satisfied that you understand the information sheet and agree to participate, you should initial every page of the information sheet and keep a copy.
- Before you participate in the project you should also have been given a consent form to sign. You must be happy that the consent form is easy to understand and spells out to what you are agreeing. Again, you should keep a copy of the signed consent form.

Tracing of research participants

- Media reports of human experimentation during times of conflict, eg. WWII, Vietnam War, have raised the issue of being able to trace study participants, some time in the future, should any problems arise that may be related to the research conducted.
- To facilitate this, ADHREC requires that the researcher provide a nominal roll of study participants for safekeeping by ADHREC, where the study is a clinical trial (eg. When the researchers are trialling a new treatment or device). We need to know who you are, only so that we can find you in the future, if there is any suggestion that the research may have been associated with the development of any health problems. **Please note: A health study is not a clinical trial, and as such does not require the researcher to provide ADHREC with a nominal roll.**
- This is consistent with current Occupational Health and Safety and Health Surveillance practices, and is encouraged under the NHMRC Statement.
- All ADHREC protocol files are secured in a locked filing cabinet and only the Secretariat has access to these. If you do need to be traced in the future, ADHREC will do this. ADHREC will not pass your contact information to a third party without your permission.
- These records will not be used to consider your medical employment standard or for compensation purposes.

Complaints

- If at any time during your participation in the project you are worried about how the project is being run or how you are being treated, then you should speak to the researchers.
- If you don't feel comfortable doing this, you can contact the Executive Secretary of ADHREC. Contact details are:

Executive Secretary, Australian Defence Human Research Ethics Committee
 CP2-7-66, Department of Defence, CANBERRA ACT 2600
 Ph: 02 62663837 Fax: 02 62664982 E-mail: ADHREC@defence.gov.au

More information

- If you would like to read more about ADHREC, you can look up the following references:
 - DI(G)ADMIN 24-3 *Function, Structure and Procedures for Obtaining Clearance for Research from ADHREC*.
 - HPD 205 *Australian Defence Medical Ethics Committee*

Or, visit our web site at <http://defweb2.cbr.defence.gov.au/dpedhs/defaultinfocentre.htm>

Appendix B: Nutrition & Catering Checklist

Preliminary:

Obtain a copy of the menu cycle and establish the meal times. (Menu can be assessed against the Draft ADF Catering Manual specs).

1. Is there provision for additional meals/foods, e.g. arduous duties allowance, after-hours or between-meals, special occasions, BBQs?
2. Does the kitchen cater for special dietary (or hospital) needs?
3. What is the kitchen size?
 - a. Number of meals prepared, number of staff, staff rosters
 - b. Skill level of staff – provision for cont education?
 - c. Description of kitchen storage & equipment (if possible a kitchen floor plan)
4. What is the opinion of the catering manager about the ADF specs for the contract (ie SUPMAN 4).
 - a. Would he/she like more /less guidance (e.g. menu planning or nutritional issues)?
 - b. Does he/she believe the existing specs allow them to fully cater to the likes/dislikes and needs of the recruits?
 - c. Has he/she suggestions for improving meal/food delivery or nutrition for the recruits (i.e. ideas which may be outside the scope of the present contract)?
 - d. Does the catering manager have access to a good range of catering/nutrition texts – are these helpful in the military context?

QUESTIONNAIRE

1. Reducing Fat in Cooking & Serving

When roasting meats, is the meat/chicken placed on a rack in a baking dish (ie does it sit in fat?)?

When roasting meats, are fruit juices, herbs and/or wine and not meat fats used for basting?

Do you make minimal use of shallow frying? (one dish or less per day) or do you use non stick pans with just a little oil?

Do you make minimal use of deep frying? How many dishes per week?

Is visible fat on meat trimmed before cooking?

Are lean cuts, lean mince and skinless chicken selected and used?

Is less margarine, oil, and/or butter used in recipes? Give an example of a fat-modified recipe.

Are recruits asked if they would like a dressing before being added to salads, or is dressing served separately?

At meals are at least two dishes served with vegetables that have no fat added (ie no cream sauce, no added dressings or oils, not roasted in fat or fried)?

If serving chips, are thick cut (12 mm or more), straight cut chips offered rather than thin and crinkled chips?

If cream is served on desserts, are recruits asked if they want cream before adding it and do you offer ice-cream or yoghurt as an alternative?

Are recruits provided with a choice of full-cream, reduced-fat and low-fat milks at each meal?

Is a flavoured milk available at one meal per day as full-cream, fat-reduced/low fat or soy milk varieties?

Are a variety of cheeses available at meals including reduced fat (ie less than 25 g fat per 100 g) or low-fat (ie less than 10 g fat per 100g)?

2. Using lower fat cooking ingredients

Is reduced fat milk (less than 2 grams per 100 mL) used in cooking?

Is reduced fat cheese (less than 25 gram per 100 g) used in cooking?

Are 'no oil' or 'low oil' dressing or reduced fat mayonnaise (ie less than 10 g fat per 100 mL) used or available?

Is natural yoghurt or evaporated milk used instead of cream in at least one of menu cycle recipes? – please submit the recipe.

Is natural yoghurt or reduced fat sour cream used instead of sour cream?

Is coconut milk or 'lite' coconut milk used instead of coconut cream?

Are any other fat-reduced products regularly used? Please describe.

3. Using healthier fats

Do you avoid the use of any of the following animal fats or high saturated fats: butter, lard, cooking margarine, coconut oil, palm oil, tallow, ghee, solid vegetable fats (e.g. HiFry, Cofa)?

Do you use monounsaturated (e.g. sunola, canola, olive, peanut) or polyunsaturated (e.g. sunflower, safflower) in cooking? Please describe.

Do you use monounsaturated or polyunsaturated margarines for sandwich preparation?

How many fish-based dishes are served each week? Please describe.

What fats do you use in baking? (e.g. pastries, biscuits, cakes, desserts)

Are a variety of spreads available at meal times e.g. butter, margarines? Please describe.

Are any of the following oils used in deep fryers Sunola™, Signature™, olive oil, or peanut oil?

Please describe your use of deep fryers, e.g. how many fryers, volume of foods fried, type of oils used, temperature commonly used, maintenance/oil clean-up procedure?

4. Increasing carbohydrate and fibre in meals

Is a choice of wholemeal, multi-grain and white sliced breads available at each meal? Are any other types of bread occasionally served?

Is plain rice (no added oil/fat) available – how often? Is brown rice and/or wild rice available – how often?

Is plain pasta available – how often? Is wholemeal pasta available – how often? Are soya-based pastas included in some vegetarian dishes?

How many dishes per week contain added legumes (e.g. lentils, chickpeas, kidney beans, butter beans, split peas)? Please describe.

Is at least one dessert each day based on fruit? Please describe recipe.

Are any of the following breakfast cereals served? Weeta-Flakes, Muesli Flakes, Weet-Bix, Sports Plus, Sustain, Fibre Plus, All-Bran, Lite 'n' Tasty, Sultana Bran, Oatmeal, Just Right, untoasted muesli, Lite Start, Nutrigrain, Corn Flakes, Special K or Rice Bubbles? Which are the most popular varieties?

Are vegetables or salads dishes available at all meals?

Is a low-fat potato dish (e.g. boiled, steamed or dry-baked) available each day?

Are fresh fruits available at each meal?

Are nuts and dried fruits available either as part of a dish or separately at meals? Please describe.

5. Reducing salt

Is salt added to food during cooking?

Is salt-reduced tomato paste, salt-reduced sauces (including soy & tomato sauces), salt-reduced tinned vegetables, salt-reduced processed meats used? – Please describe.

Is MSG (monosodium glutamate) added to any dishes?

Are herbs, spices and lemon juice used rather than salt-based flavour enhancers? Please describe.

Is an unsalted or salt-reduced margarine (i.e. 120 mg sodium per 100 g or less) used? Please describe.

6. Water

Is plain chilled water available at each meal?

Appendix C: Focus Group Discussion

Focus group discussion was held at 17:00 h 6th November 2003 on day 37 (week6) of the Army Common Recruit training Course. Forty-four recruits from 2 platoons participated in the discussion.

Q What foods do you generally eat when you go to the mess?

- Mainly eat the meat-based stews and pasta dishes due to the volume they are allowed to have even though they don't like them.
- Would prefer to have larger quantities of whole meats but the amount allowed to take is restricted (1 piece/recruit).
- Schnitzel was also a favourite because it could be eaten in a sandwich.
- All - always have mashed potato.
- 'Fast food' type items such as meat pies and hot dogs are popular ('fast food' items always go very quickly and many miss out).
- 13 from one of the platoons (n = 22) chose a large quantity of vegetables, other 9 ate vegetables but only a small quantity.

Q How do you choose the food that you put onto your plate when you have a meal at the mess?

- Food choices were mostly based on the ease of eating, speed of delivery to their plates and the volume they are allowed to take. (For example, wet dishes were eaten more often than meat cooked by frying, roasting or baking. Meat such as steaks or chops were well liked, but chosen less often because they could only have 1 small serve and often had to wait for the meat to be served at the counter)
- Half the recruits in one platoon and 2 in the other platoon made their food choices based on health reasons. (2 recruits commented that they specifically chose the carbohydrate-rich foods)
- Because popular menu items run out quickly, choice is often limited to only a few dishes. (for example, more recruits would choose salad items – but these dishes ran out quickly)
- Menu choice was further decreased, because previous menu dishes were often recycled.
- Not enough whole meats were offered, particularly for use in sandwiches.
- Not enough whole grain breads, yoghurt or a good variety of fruit were offered. (For example, recruits would prefer fewer oranges and more bananas)

Q What foods do you avoid at the mess? Why?

- Majority dislike the stews and casseroles, but eat them for the reasons stated above.
- Salads – poor variety, strange salad mixes and no salad dressing offered.
- Eggs at breakfast -- poorly cooked.
- Custard--very poor quality.
- Chops/Steak – undercooked and only allowed 1 piece.
- Fish – off/not cooked properly, no lemon offered. 2 recruits believe they may have got food poisoning from the fish. Thus, all recruits in this platoon avoid the fish.

- Chicken – poor cuts, too many bones and not enough meat.

Q How do you make the choice to avoid a certain food?

- Poor food quality.
- Small serve size
- Lots of fat in the meal.
- If the chef is rude.
- If it takes too long to serve or eat

Q Do you take fruit from the mess? When do you eat it?

- All take 2 or 3 pieces back to lines and place in designated fruit container.
- Not enough or a great enough variety offered at the mess. For example, bananas are popular and 'run out' quickly.
- The fruit offered is often not fresh or ripe.
- Recruits can access fruit bin when time permits – but during personal/platoon admin they are restricted to eating in their rooms only.
- Most eat at night, only.
- Some recruits take pieces of fruit to their lessons, in their backpacks, to eat during their breaks but are not sure if this is allowed – but haven't been caught/reprimanded.
- Not when out on the range.

Q What do you think of the time you have to eat your meals?

- All recruits agreed time to eat is too short.
- All felt under pressure to cut all of their meal times short.
- Many often don't finish their meal, because of insufficient time.
- 13 recruits said that they had skipped at least one meal during their training.
- Others stated that if they are running short on time they would take a hot box.

Q For what reasons would you skip a meal?

- Not enough time to eat.
- Poor quality of the meal provided
- Recruits on ROP (restriction of privileges) would often miss a meal because hot boxed meals were not ordered.
- Not hungry (for example, after local leave and War Memorial visit.)

Q If given more time for meals, would you stay longer at the mess? Eat more/less?

- Yes -- but only for an extra 5 – 7 mins not the entire time.
- Better organisation at the servery, would allow recruits more time to eat. For example, recruits often had to wait in line, while dishes were being brought out or because serving utensils, crockery or cutlery were not available.
- About half thought they would eat more food, others thought they would eat the same, but more slowly and 2 thought they would eat less.

Q How do you feel about current meal times?

- All recruits stated that they felt hungry during the day – particularly when out at the range.

- 14 recruits would like food between meal times, but eight thought this would be impractical.
- Recruits would like cordial provided in lines and snack items which could be carried with them during the day. For example fruit, muesli bars.
- Preferred times for snack items were during platoon admin, lesson breaks, after PT sessions

Q How would you benefit from eating extra foods/meals?

- 19 recruits thought extra foods would help reduce hunger. 3 recruits did not.
- 21 recruits thought extra foods would boost energy. 1 recruit did not.
- 1 recruit said that it would assist in reducing weight loss.

Q Are you obtaining food outside the mess? Where? When? How much?

- All recruits have bought food/drinks from vending machines. On average about once per week.
- Most recruits drink up to between 2 and 4 L water per day, outside the mess.
- All recruits ate foods/drinks from the Everyman. Recruit really appreciated this service. The biscuits and coffee were well liked. Some recruits suggested they would like power/energy drinks served.

Q Generally how do you feel about the food provided during the ACRT?

- About half thought the food provided was not good enough, while the other half thought that quantity and not quality was the issue.
- All thought that the food could be improved. For example: more meats for making sandwiches, more dairy foods – and greater variety, more salads, better selection of fruits, more fruit, better menu choices and more cereal and grain-based foods. (See preceding comments)
- Vegetarian options were poor – a greater variety is needed. “The stir fries are soggy and terrible”
- Want more snack items such as dried fruits, nuts and muesli bars, which can be taken away from the mess.
- Hot boxes were not liked. The serves were too small and the choices limited. For example, they received one muffin for breakfast, which was not enough to satisfy hunger.

Appendix D: Nutritional Breakdown of SUPMAN 4 & Snacks Available from Outside the Recruits' Mess

Nutrient breakdown for Serial items in SUPMAN 4 Chapter 7, Entitlement Table 1

Ser					Number of Core Food Group Serves	Nutrient Content			
					Energy (kJ)	Protein (g)	Fat (g)	Carbohydrate (g)	
Milk	Whole	1	750ml	3 Dairy	2100	25	30	36	
Fresh Meat	cuts	2	400g	4 Meat	2400	81	27	0	
	boneless, trimmed of fat								
Eggs	Fresh	3	1 large	1 Meat	400	8	7	0	
Bacon	rashers	4	30g	½ Extra	120	4	1	0	
Potatoes		5	400g	4 Vegetable	1200	10	0	53	
Fresh Fruit,		6	340g	2 Fruit	800	3	0	41	
Vegetable		6	560g	7-10 Vegetable	1000	9	3	39	
Bread	Fresh	7	550g	8 Cereal	5600	46	14	246	
Butter		8	65g	3 Extra	2000	0	53	0	
Jam	assorted	9	32g		340	0	0	21	
Sugar	White	10	80g	3.2 Extra	1300	0	0	80	
Tea		13	9g		1	0	0	0	
Fruit	Juice	14	90ml	0.72 Fruit	140	0	0	8	
Fresh Baking		15	1.4g		9	0	0	0	
Powder									
Pepper		16	0.9g		10	0	0	0	
Various									
Salt	Fine	17	8g		0	0	0	0	
Custard		19	4g		60	0	0	3	
Powder									
Tomato	Sauce	20	32ml		150	0	0	80	
Flavour		22	5g		50	1	0	1	
Boosters									
Gelatine		25	7g		100	6	0	0	
Mixed	Peel	26	2g		20	0	0	1	
Total					17800	193	135	537	

Nutritional Profile of Entitlement Table 1, Chapter 7, SUPMAN 4

Nutrient	Avg/Day	RMDI *	%
Energy (kJ)	17800	16000	108%
Protein (g)	193	127	350%
Total Fat (g)	135	125	120%
Saturated Fat (g)	70	32 **	219%
Monounsaturated Fat (g)	40	56 **	71%
Poly-unsaturated Fat (g)	12	6 **	200%
Cholesterol (mg)	812	300 **	271%
Carbohydrate (g)	540	575	108%

* RMDI for Activity Level 3, ** Values from Food Works version 3.1 (Xyris Software)

Food available outside the recruits' mess

Food Outlet	Typical Items Consumed	Number of occasions during ACTR	Average Daily Nutrient Contribution (over 45 d)			
			Energy (kJ)	Protein (g)	Fat (g)	Carbohydrate (g)
Everyman	Biscuits, soft drinks, chocolate bar, hot drinks (e.g. coffee, Milo)	~ 12	400	1	4	15
Padre	Chocolate blocks (90g)	1.5 d, (wk 4)	90	0.3	1	2
War Memorial Visit	2 take-away meals (e.g. KFC), commercial snacks and drinks	1 (wk 6)	300	2	3	9
½ day local leave	Take-away meal (e.g. KFC), commercial snacks and drinks	1 (wk 4)	70	0.3	1	2
Frontline /Post Office	Potato crisps, chocolate bars, soft drinks, flavoured milk, Sports/energy drinks	~ 2	80	0.4	0.8	3
Vending machines	Potato crisps, chocolate bars, soft drinks	~ 5	150	0.5	2	5
Total			1100	4	12	36

Appendix E: Suggested Menu Plans for Recruits

Appropriate nutritional status is a pre-requisite to optimal physical and cognitive military performance. The nutritional goal during Army recruit training is to optimise nutritional status so the recruit will have the stamina and body reserves of energy needed to meet the physical and mental demands of recruit training. Recruits should be provided with sound nutrition information and healthy food alternatives, and be encouraged to make appropriate food choices.

The menu plans suggested in this document have been derived from *The Australian Guide to Healthy Eating* (www.health.gov.au/pubhlth/strateg/food/guide/guide2.htm) and the 'core food groups' identified by The National Health and Medical Research Council (NHMRC 1995) as being of greatest nutritional value. The menus are designed to provide the optimum balance of energy and carbohydrate (Table 1) to meet the needs of recruits, as determined by Skiller et al (2003). The core food groups are presented in Table 2, with the minimum suggested number of serves for each food group.

General Advice

The optimum diet for training and recovery must:

- Provide sufficient energy, protein, carbohydrate, fat, vitamins, minerals and fluid to meet the requirements of the ACRT.
- Enable the recruit to achieve and maintain an appropriate body weight and level of body fat.

The recruits should eat mostly carbohydrate-rich foods – which should provide up to 55% of their energy needs – from wholegrain and wholemeal breads, cereals, rice, legumes, pasta, fruit and starchy vegetables. Protein foods should be eaten in moderation – choose from meats without visible fats such as skinless chicken, lean beef, lean cuts of lamb and pork, fish cooked without batter, eggs boiled or poached. Fats provide energy, too – but should only be eaten sparingly from vegetable and fish sources rather than animal or dairy products.

A moderate level of training is considered to be 1 to 2 hours of intense or lengthy medium intensity physical exercise per day and requires around 6–8g of carbohydrate per kg body weight, or 400–500 g of carbohydrate per day. On days when this level of activity is exceeded, carbohydrate intake should be increased accordingly. The usual daily catering menu for the ACRT should provide around 17 MJ and should be provided as 5 to 6 meals as shown in table 1.

Table1: Minimum energy and carbohydrate breakdown of suggested meal plans for male & female Army recruits

	Male		Female	
	Energy (kJ)	Carbohydrate (g)	Energy (kJ)	Carbohydrate (g)
Breakfast	3000 - 4000	100 - 140	2500 - 3000	80 - 100
Lunch	3000 - 4000	100 - 140	3000 - 3500	80 - 100
Dinner	3000 - 4000	100 - 140	2500 - 3000	80 - 100
Between-meals	1000 - 2000	~50 - 100	~1000	~50

Table 2 describes the Core Food Groups and gives the recommended minimum number of daily serves for male and female recruits.

Table 2: Core food groups & minimum suggested sample serves per day for the ACRT

	Approx Energy per serve (kJ)	Example Serves	Serves (male)	Serves (female)
Cereal	600	2 slices bread, 1 med bread roll 1 cup cooked rice, pasta, noodles 1 cup cooked porridge, 1.3 cup RTE cereal ½ cup natural muesli, 1/3 cup flour	10	7 - 8
Vegetable	75 - 250	½ cup cooked vegetables ½ cup cooked dried beans, peas or lentils 1 cup salad vegetables, 1 small potato	5	5
Fruit	300	1 medium piece of fruit, 2 small pieces of fruit 1 cup diced fruit pieces or canned fruit 1 ½ tablespoons sultanas, dried fruits ½ cup fruit juice	2-3	2
Dairy	375-730	1 cup milk (fluid), 1 cup soy milk 1.2 cup evaporated milk, 2 slices cheese 1 small carton yoghurt	3	3
Meat	600-850	65-100g cooked meat or chicken ½ cup cooked beans, lentils, chickpeas, split peas or canned beans 80-120g cooked fish fillet, 2 small eggs 1/3 cup peanuts, almonds ¼ cup sunflower seeds, sesame seeds	2 - 3	1 -2
Extra	600	1 doughnut, 4 plain sweet biscuits 1 slice cake (40g), 25g chocolate (1/2 small bar) 2 tablespoons cream, mayonnaise 1 tablespoon butter, margarine, oil 1 ½ tablespoon sugar 200mL wine or 60mL spirits, 600mL light beer or 400 mL regular beer 1 can soft drink, 1 small packet potato crisps (30g) 1/3 meat pie or pasty, 12 hot chips 1 ½ scoops icecream	3	2 -3

The example menus at the end of this document provide the minimum Core Food Group serves.

Nutritional support for RFA, obstacle course, endurance marches and bayonet drills

These physically demanding activities are usually conducted over a 2 hour period either in the early morning or in the case of the bayonet drills, in the early afternoon. Usual practice is for recruits to eat breakfast in the hour preceding the early morning activities and in the case of the bayonet drill, lunch is eaten just prior. Recruits should avoid eating protein and fat-rich foods and select carbohydrate-rich foods for these meals.

Currently between-meal snacks are not provided immediately after the activities. Optimal recovery from exercise is important for training to be fully effective, and depends on replacing fluids and electrolytes and replenishing muscle glycogen (the muscle's major source of energy during vigorous physical activity). Recruits should start drinking fluids immediately exercise is completed and eat a snack containing around 1 g carbohydrate per kg body weight within 15 minutes (i.e. equivalent of two between-meal snack items for males or one for females (see Table 3). The next meal (lunch or dinner) should also be carbohydrate-rich and should be eaten about two hours later. Table 3 gives a suggested meal plan for the early-morning activities. In the case of the bayonet drills, lunch should finished at least 30 mins before commencement and should provide extra carbohydrate—for example 2 cups pasta with tomato and bean sauce, 1 piece fresh fruit and a glass of cordial (3000 kJ, 150g carbohydrate).

Table 3: An example of a nutrition plan for early-morning arduous activities

Activity	Food	Carbohydrate (g)	Energy (kJ)
Breakfast 06:00h	2or 3 large pancakes (55g) with ½ cup maple-flavoured syrup 1 medium banana 1 glass cordial or fruit juice	200	3600
07:20 to 09:00h Physical activity	Plenty of water OR if the activity is continuous over the period, 500mL cordial/fruit juice/mineral water or 800mL sports-type drink		
09:00 – 0915 Morning	2 high-carbohydrate snacks (see Table 4)		
Tea		100	2000

Nutritional support for extended arduous activities

Good nutrition during the preceding weeks is important to ensure that the recruits' liver and muscle glycogen stores are optimal before engaging in the vigorous and sustained activity required to pass the RFA and complete the Challenge.

Extra carbohydrate will be needed for at least 2 days before the recruits undergo Exercise Dusty Warrior and the final Challenge. They will need up to 10 g extra carbohydrate per kg of body weight (about twice their usual consumption). To achieve optimal glycogen stores, this extra carbohydrate should be combined with 'tapering' of training over several days prior to the period of vigorous activity, with recruits having little or no exercise on the final lead-up day. This 'carbohydrate loading' procedure will safely and effectively enhance physical endurance performance.

To achieve this increased carbohydrate consumption, recruits will need to eat a minimum of 2 serves of breakfast cereal, 6 slices of wholemeal bread (or 3 rolls), 2 cups cooked pasta/noodles, 1 cup cooked rice, 3 high carbohydrate snacks (table 4), 3 pieces of fruit and 1 L of cordial per day.

To ensure optimal hydration status, recruits should drink plenty of fluids leading up to Exercise Dusty Warrior and the final Challenge. Indicators of adequate hydration status include frequent voidings (i.e. every few hours) of high volumes of clear urine. Dehydration to as little as 2-3% of body weight is enough to adversely affect performance.

To allow for complete digestion and absorption, breakfast should be carbohydrate-rich (e.g. Table 3) and should be finished an hour before the first march. It is best to avoid fatty or protein-rich foods in this meal. Recruits should choose high carbohydrate foods with minimal fibre content. Suitable foods include honey or jam on white bread, banana smoothie made from skim milk, white rice or pasta with tomato and vegetable-based sauce; pancakes with syrup; pikelets with jam; low-fibre cereals with skim milk (e.g. Cornflakes, Rice Bubbles, Nutri-grain).

Recruits should drink fluids in moderate amounts frequently (e.g. 150 – 200 mL every 20 min, or even more in hot weather, up to a rate of about 1 L/h). Water is adequate. Sports drinks, diluted cordials or flat soft drinks—preferably cooled (but not cold)—are beneficial if continuous exercise is maintained for more than one hour and is conducted in the heat.

A high carbohydrate snack should be provided mid-morning – for example 2 snacks from Table 4 or the muesli bars/biscuits/chocolate/candy/fruit/noodles/cordial from the combat ration pack.

If relying on combat rations, recruits should eat all the contents of the ration pack (CR1M) in 24 hours. It is best to eat the pack as 3 meals and 3 mid-meals/ drinks (ie don't go longer than a few hours without eating or having a sweet drink).

Table 4 Carbohydrate-rich snacks containing about 50g carbohydrate

	Snack
1	1 cup (250 mL) of high carbohydrate supplement (e.g. Exceed High Carbohydrate source)
2	800 mL of sports drink or 500 mL (2 cups) of diluted cordial. Note that Nutrition Australia provides instructions for making an inexpensive sports drink at: < http://www.nutritionaustralia.org/Food_Facts/FAQ/sports_drinks_faq.asp >
3	500 mL of fruit juice, soft drink or flavoured mineral water
4	1 (min 50 g) packet of jelly beans or jelly lollies
5	1 tin (237 mL) of sports nutrition supplement (Exceed or Sustagen) or a home-made low-fat milk shake/fruit smoothie: blend together 600 mL skim milk + 1/2 cup low-fat yoghurt + 1 piece fruit.
6	One round of jam sandwiches (thick slices of bread and lots of jam!)
7	3 medium pieces of fruit (e.g. apple, orange and banana)
8	1 carton low-fat flavoured milk + 2 plain sweet biscuits
9	2 large plain-sweet biscuits, cup of hot Milo/chocolate made with 50:50 skim milk: water
10	1 small low-fat muffin with jam or honey (ie made with 50g flour)
11	Cup of thick-vegetable soup with a wholemeal roll (e.g. Minestrone or pea and ham)

-
- 12 Salad sandwich and a piece of fruit
 - 13 Carton of low-fat fruit yoghurt and a muesli bar (not chocolate)
 - 14 Large baked potato (250–300 g) with low-fat filling and a glass of skim milk
 - 15 Bowl of cereal with skim milk
 - 16 Bowl of fruit salad with 1 carton of low-fat fruit yoghurt
 - 17 1 cup rice with vegetables (stir-fried in small amount oil or boiled only)
 - 18 1.5 cups pasta/noodles with vegetable-based sauce or soup (e.g. 1 pkt instant noodles)
-

Example Menus

Males: Avg 15.5 MJ, 160g protein, 120g fat and 160g carbohydrate

Menu One

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	4 Weetbix with skim milk	3			1		
	2 pieces of wholegrain toast + Canola marg + jam/honey/p'nut paste		1			1	0.5
	0.5 cup of baked beans, 2 small eggs poached, 1 grilled rasher of bacon			1			0.5
	0.5 cup of orange juice						
Morning Tea	1 Packet instant noodles						
Lunch	1 mixed grain bread roll + Canola margarine	1					0.5
	1 cup of pasta salad, ½ cup coleslaw	1	1				
	1 cup mixed green salad with dressing		1				
	0.75 cup skinless chicken breast					1	
Afternoon Tea	1 medium dessert muffin	1					
	1 PCP carton reduced fat flavoured milk				1		
	2 chocolate chip biscuits						0.5
	Beef stew (1 cup)					1	
Dinner	1 cup of cooked white rice	1					
	0.5 cup mashed potato		1				
	0.5 cup of cooked carrot		1				
	5 flowerets of broccoli		1				
Supper	2 slices of wholemeal bread + Canola marg	1					0.5
	1 cup of fresh fruit salad			1			
	2 scoops of low fat ice cream						1
	4 crispbreads	1					
	45g reduced fat cheddar cheese (50% fat reduced)				1		
Total		9	6	2	3	3	3.5

Menu Two

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	1 cup of muesli + skim milk	2			1		
	2 slices wholegrain toast + canola marg + jam	1					0.5
	2 med. plain pancakes + honey/syrup	1					
	0.5 cup of orange juice			1			
Morning Tea	1 med raw apple			1			
	1 tub (200 g) of reduced fat fruit yoghurt				1		
	1 cup of beef mince stew in tomato base sauce					1	
	2 cups of cooked pasta	2					
Lunch	1 cup of mixed green salad with dressing		1				
	1 medium chocolate muffin	1					
	2 slices of wholemeal bread + canola marg	1					0.5
	1 med. Banana			1			
Afternoon Tea	1 medium apple			1			
	1 serve of salmon pasta bake	0.5				1	
	2 sm. boiled potatoes with skin		2				

Supper	0.5 cup of boiled pumpkin		1				
	5 broccoli flowerets		1				
	2 slices of wholemeal bread (toasted) + canola marg	1					0.5
	2 scoops of low fat ice cream						1
	0.5 cup of flavoured jelly						0.5
	2 large Anzac biscuits						0.5
	1 cup hot Milo/chocolate (50:50, skim milk: water)				0.5		
Total		9.5	5	4	2.5	2	3.5

Menu Three

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	1 cup of breakfast cereal (45g) not muesli + skim milk	2			1		
	1 sm. hard boiled egg						
	0.5 cup of orange juice			1		1	
Morning Tea	2 slices of wholegrain toast + Canola marg + jam/honey/p'nut paste	1					0.5
	2 med. fruit/vegetable bran muffins	2		1			
	2 serves of jam or honey						1
Lunch	1 hamburger with lettuce, tomato and cheese	1.5	0.5		0.5	1	
	0.5 cup of coleslaw with dressing		1				
	1 cup of pasta salad with vegetables and dressing	1					
Afternoon Tea	1 PCP carton (300 mL) of flavoured skim milk				1		
	1 med. mandarin			1			
Dinner	2 med. slices of roast lamb (trimmed fat)					1	
	2 sm. potatoes, peeled, dry baked		2				
	0.5 cup of dry baked pumpkin		1				
	0.5 cup brussel sprouts		1				
	2 slices of wholemeal bread + canola marg	1					0.5
Supper	1 cup of creamed rice pudding	1					
	4 plain sweet biscuits						1
	1 cup hot Milo/chocolate (50:50, skim milk: water)				0.5		
Total		9.5	5.5	3	3	3	3

Females: Avg 12.2 MJ, 140g protein, 100g fat and 340g carbohydrate

Menu One

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	2 weetbix + skim milk	1			1		
	2 slices of wholegrain toast + canola marg + jam/honey/p'nut paste	1					0.5
	0.5 cup of baked beans + 2 sm. eggs poached +1 rasher of bacon		1	1		1	0.5
	0.5 cup of orange juice						
Morning Tea	1 packet instant noodles	1					
Lunch	1 mixed grain bread roll + canola marg	1					0.5
	1 cup of pasta salad with vegetables and dressing	1					
	1 med. fruit/ vegetable muffin	1					
	0.5 cup of coleslaw with dressing		1				
	1 cup mixed green salad with dressing		1				
Afternoon Tea	0.75 cup skinless chicken breast					1	
	1 PCP carton (300 mL) of skim milk				1		
	2 chocolate chip biscuits						0.5
Dinner	1 cup of cooked white rice	1					
	0.5 cup mashed potato		1				
	0.5 cup of cooked carrot		1				
	5 flowerets of broccoli		1				
Supper	1 cup of beef stew					1	
	4 crisp breads	1					
	45g reduced fat cheddar cheese (50% fat reduced)				1		
Total		8	6	1	3	3	2

Menu Two

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	0.5 cup of muesli + 0.5 cup skim milk	1			0.5		
	2 slices of toasted wholemeal fruit bread + canola marg	1					0.5
	2 med. plain pancakes+ honey/syrup	1					
	0.5 cup of orange juice			1			
Morning Tea	1 med raw apple			1			
	1 tub (200 g) of reduced fat fruit yoghurt				1		
Lunch	1 cup of beef mince stew in tomato base sauce					1	
	2 cups of cooked pasta	2					
	1 cup of mixed green salad with dressing		1				
	1 medium chocolate muffin	1					
Afternoon Tea	1 slice of wholemeal bread + canola marg	0.5					0.25
	1 med. banana			1			
Dinner	1 serve of salmon pasta bake	0.5				1	
	2 sm. boiled potatoes with skin		2				
	0.5 cup of boiled pumpkin		1				
	5 broccoli flowerets		1				
Supper	1 slice wholegrain toast + canola marg	0.5					0.25
	2 large Anzac biscuits						0.5
	1 cup hot Milo/chocolate (50:50, skim milk: water)				0.5		
Total		7.5	5	3	2.0	2	1.5

Menu Three

Meal	Food	Cereal	Vegetable	Fruit	Dairy	Meat	Extra
Breakfast	0.5 cup of breakfast cereal (not muesli) + 0.5 cup skim milk	1			0.5		
	1 sm. hard boiled egg			1		1	
	0.5 cup of orange juice	1					0.5
	2 slices of wholegrain toast + canola marg						
Morning Tea	2 med. fruit/vegetable bran muffins	2		1			
	2 serve jam or honey						1
Lunch	1 hamburger with lettuce, tomato and cheese	1.5	0.5		0.5	1	
	0.5 cup of coleslaw with dressing		1				
	1 cup of pasta salad with vegetables and dressing	1					
Afternoon Tea	1 PCP carton (300 mL) flavoured skim milk				1		
	1 large mandarin			1			
Dinner	2 med. slices of roast lamb (trimmed fat)					1	
	1 sm. potatoes, peeled, dry baked		1				
	0.5 cup of dry baked pumpkin		1				
	0.5 cup brussel sprouts		1				
Supper	1 slice of wholemeal bread + canola marg	0.5					0.25
	1 cup of creamed rice pudding	1					
	2 plain sweet biscuits						0.5
	1 cup hot Milo/chocolate (50:50, skim milk: water)				0.5		
Total		8	4.5	3	2.5	3	2.25

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19. ABSTRACT The nutritional status and fatigue level of Army recruits undergoing the Army Common Recruit Training (ACRT) course was assessed. This was achieved via the evaluation of the food services at the Army Recruit Training Centre, recruits dietary intake and the estimation of recruits total energy expenditure for the entire course and the most arduous activities of recruit training. Recruits were found to be consuming less energy than their requirements and a diet inappropriate for strenuous training — high in fat and low in carbohydrate. There was evidence that the recruits' nutritional requirements were not being met during the course: a small weight loss experienced by most recruits; comments by recruits and researcher observations; and the fact that recruits felt hungry between meals. During the study period recruits were provided with three meals per day. A more appropriate eating pattern would be three meals each consisting of a minimum 2.5 MJ to 4MJ and 100 to 140 g carbohydrate, and two or three between meal snacks each consisting of around 1 - 2 MJ and 50 - 100 g of carbohydrate. Extra energy supplied in the form of carbohydrate and different timing of meals would assist recruits through the very arduous days of the ACRT course.					